Parallel Cellular Algorithm

Application : Image Edge Detection

Code:

```
import cv2

import numpy as np

from multiprocessing import Pool, cpu_count

from google.colab.patches import cv2_imshow # Import cv2_imshow for displaying images in Colab

# Function to apply Sobel operator to a small image chunk

def apply_sobel(chunk):

# Sobel kernels

sobel_x = np.array([[-1, 0, 1], [-2, 0, 2], [-1, 0, 1]])

sobel_y = np.array([[-1, -2, -1], [0, 0, 0], [1, 2, 1]])

# Pad chunk to handle edge cases

padded_chunk = np.pad(chunk, ((1, 1), (1, 1)), mode='constant')

edge_chunk = np.zeros_like(chunk)

# Apply Sobel operator

for i in range(1, padded_chunk.shape[0] - 1):

for j in range(1, padded_chunk.shape[1] - 1):

region = padded_chunk[i-1:i+2, j-1:j+2]

gx = np.sum(region * sobel_x)

gy = np.sum(region * sobel_y)

edge_chunk[i-1, j-1] = min(255, np.sqrt(gx**2 + gy**2)) # Gradient magnitude
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return edge_chunk

# Function to split the image into chunks

def split_image(image, num_chunks):

h, w = image.shape

chunk_height = h // num_chunks

# If image height is not divisible by num_chunks, ensure the last chunk gets the remaining rows

chunks = [image[i * chunk_height:(i + 1) * chunk_height] for i in range(num_chunks - 1)]

chunks.append(image[(num_chunks - 1) * chunk_height:]) # Add the last chunk with remaining rows

return chunks

# Function to combine chunks back into a single image

def combine_chunks(chunks):

return np.vstack(chunks)

# Main function to process the image

def parallel_edge_detection(image_path, num_workers=None):

if num_workers is None:

num_workers = cpu_count()

# Load image in grayscale

image = cv2.imread(image_path, cv2.IMREAD_GRAYSCALE)

if image is None:

raise FileNotFoundError(f"Image file not found: {image_path}")

# Split the image into chunks for parallel processing

chunks = split_image(image, num_workers)

# Process each chunk in parallel

with Pool(num_workers) as pool:
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processed_chunks = pool.map(apply_sobel, chunks)

# Combine the processed chunks

edge_image = combine_chunks(processed_chunks)

return image, edge_image

# Example usage

if __name__ == "__main__":

print("Chaitanya N 1BM22CS076")

input_image_path = "/content/image.jpeg" # Replace with your image path

output_image_path = "output_edge_detected.jpg"

# Run edge detection

original_image, edge_detected_image = parallel_edge_detection(input_image_path)

# Save the edge-detected image

cv2.imwrite(output_image_path, edge_detected_image)

# Combine original and edge-detected images side by side

combined_image = np.hstack((original_image, edge_detected_image))

# Display the combined image in Colab

cv2_imshow(combined_image)

print(f"Edge-detected image saved as: {output_image_path}")
```
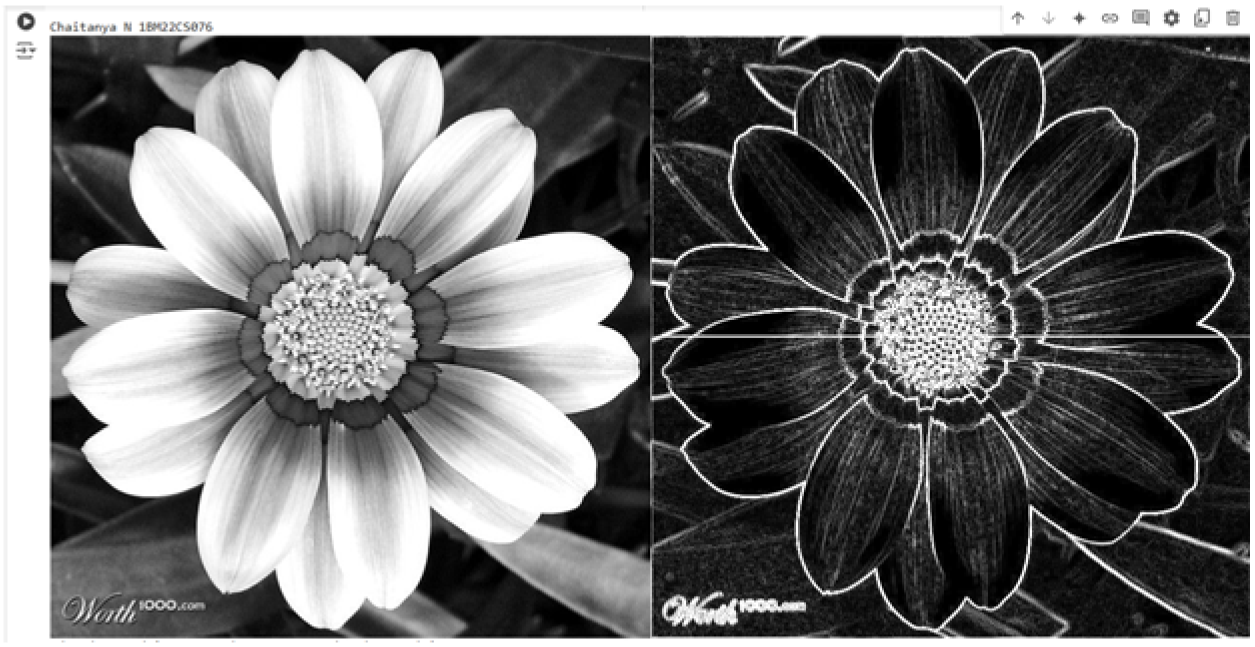

Output :


Chaitanya N 1BM22CS076